SANITATION I: HUMAN EXCRETA DISPOSAL

Dr Elizabeth O. Oloruntoba
Dept of Community Medicine, Bowen University
elizabeth.Oloruntoba@bowen.edu.ng
What is Sanitation?

• Sanitation refers to the provision of facilities and services for the safe management of human excreta from the toilet to containment and storage and treatment onsite or conveyance, treatment and eventual safe end use or disposal

(WHO definition)
• Inadequate sanitation is a major cause of infectious diseases such as cholera, typhoid and dysentery world-wide

• It also contributes to stunting and impaired cognitive function and impacts on well-being through school attendance, anxiety and safety with lifelong consequences, especially for women and girls

• Improving sanitation in households, health facilities and schools underpins progress on a wide range of health and economic development issues including universal health coverage and combatting antimicrobial resistance.
Human Excreta Disposal Methods

Excreta disposal: an important public health issue

• What happens if excreta is not adequately disposed?
Excreta can cause diseases in 2 ways:

1. Infected excreta
   - New host

2. Excreta
   - Vector breeding

Disease transmission is determined by several pathogen-related factors including:

- Excreted load: the number of pathogens excreted
- **Latency**: the period it takes excreted pathogens to become infective once excreted. Many excreted pathogens are non-latent e.g. bacteria, viruses & protozoa.

- **Persistence**: how long pathogen survives in the extra-intestinal environment, e.g. Ascaris eggs can survive many months - years

- **Multiplication**: whether pathogen can multiply in the extra-intestinal environment, e.g. excreted bacteria in food and milk.

- **Infective dose**: number of pathogens required to cause infection
• Disease transmission is also affected by host characteristics and behaviour, including:
  – immunity (natural or as a result of prior infection or vaccination)
  – nutritional status
  – health status
  – age
  – sex
  – personal hygiene
  – food hygiene.
Excreta-related diseases

• These are diseases caused by transmission of pathogens in the faeces or urine of an infected person to a new host.

• One of the principal benefit of sanitation is to improve health.

• This purpose can be achieved only with a clear understanding of the diseases that are most prevalent when sanitation is poor.

• These diseases are known as excreta-related diseases, and classification is based on their environmental transmission routes.
<table>
<thead>
<tr>
<th>Category</th>
<th>Examples of Infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Faecal-oral (non-bacterial)</td>
<td>- Hepatitis A (V)</td>
</tr>
<tr>
<td></td>
<td>- Amoebic dysentery (P)</td>
</tr>
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<td></td>
<td>- Hymenolepiasis (H)</td>
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<tr>
<td>Non-latent, low infective dose</td>
<td></td>
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<tr>
<td>II) Faeco-oral (bacterial diseases) –</td>
<td>- Cholera</td>
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<tr>
<td></td>
<td>- Typhoid</td>
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<tr>
<td></td>
<td>- Salmonellosis</td>
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<tr>
<td>non-latent, medium/high inf. Dose, can</td>
<td></td>
</tr>
<tr>
<td>multiply</td>
<td></td>
</tr>
<tr>
<td>III) Soil transmitted helminths-latent &amp;</td>
<td>- Ascariasis</td>
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<tr>
<td>persistent, no intermediate host</td>
<td>- Hookworm infection</td>
</tr>
<tr>
<td>IV) Beef and pork tapeworms – latent, persistence with cow/pig intermediate host</td>
<td>Taeniasis</td>
</tr>
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<tr>
<td>V) Water-based helminthiases – latent, persistent, with aquatic intermediate host(s)</td>
<td>Schistosomiasis, Clonorchiasis</td>
</tr>
<tr>
<td>VI) Excreta-related insect vector</td>
<td>Infections in I-III transmitted mechanically by flies and cockroaches, Bancroftian filariasis transmitted by <em>Culex quinquefasciatus</em></td>
</tr>
</tbody>
</table>
Hazards of improper excreta disposal

- Soil pollution,
- Water pollution
- Contamination of foods
- Proliferation of disease vectors, e.g. flies
- Disease transmission
Transmission of excreta-related diseases

Basic Health Principle to prevent disease transmission is provision of sanitary excreta disposal facilities
The Sanitation Crisis

• 2.5 billion people lack the dignity and health offered by access to a safe, decent toilet and protection from untreated waste

• 2.1 billion urban residents use facilities that do not safely dispose of human waste

• Eliminating OD reduces stunting.

• This effect is 4-5 times larger in urban areas than in rural areas
Characteristics of a sanitary excreta/Domestic Wastewater disposal method

- Must not pollute the surface of the soil, surface water or groundwater,
- Should not be unsightly or smelly (or create nuisance)
- Must not make excreta/sewage accessible to flies or animals,
- There must be no handling of fresh faecal matter / sewage,
- Method must be simple and inexpensive and should be acceptable in terms of cultural belief of the community
Principles of Excreta Disposal Structures

• They should be safe, e.g. it should not be possible for small children to fall into the latrine pit
• They should be built using hygienic and easy to clean materials
• They should be accessible to all sections of the community including young and old
• They should be designed to minimize the proliferation and habourage of disease vectors
• They should provide a degree of privacy to the users
• They should be located to avoid contamination of water sources
Methods of Excreta Disposal

Methods could be grouped as follows:

I  (a)  Water dependent
    (b)  Water independent

II (a) Network (sewerage), water dependent
     (b) Non-network
         - Non-network, water independent
         - Non-network water dependent

III (a) On-site
      (b) Off-site
A. Non-network, water-independent excreta disposal methods (no transport, no water)

• Deposition into bush/drain
• Bucket or pail latrine
• Pit latrine
• Sanplat latrine
• Ventilated Improved Pit Latrine (VIP)
• Reed Odourless Pit Latrine
• Compost Pit Latrine
Traditional Pit Latrines

- 3 parts, superstructure, reinforced concrete floor and pit
- Excreta in pit decomposed to gas, liquid and solid
- Disadvantages
  - Odour, vector breeding, heat, & poor construction sometimes leading to collapse
Ventilated Improved Pit Latrine

- Upgraded pit latrine with vent pipe and fly-screen for Odour and insect control
- Vent pipe higher than the superstructure (≤ 0.5m) is fitted at the end by a mesh (flyscreen) stops flies from entering.
Reed Odourless Earth Closet (ROEC)

ROEC is similar to the VIP latrine except for the fact that the pit is completely offset and excreta is introduced into the pit via a chute. A vent pipe is provided to minimize odour and fly nuisance. The disadvantage of the ROEC is that the chute is easily fouled with excreta and thus may provide a site for fly breeding. Therefore the chute has to be cleaned regularly with a long-handled brush. In spite of this disadvantage, ROECs are sometimes preferred to VIP latrines because of the following reasons:

• Large pit size and thus longer life than other shallow pits;
• Pit is completely displaced, hence users have no fear of falling inside;
• It is not possible to see the excreta
• The pit can be easily emptied, so that the superstructure can be a permanent facility
Ecological sanitation - What is it?

• **Ecological sanitation**, also known as ecosan or eco-san, is a sanitation process that uses human blackwater and sometimes immediately eliminates fecal pathogens from any still present wastewater (urine) at the source.

• The objectives are to offer economically and ecologically sustainable and culturally acceptable systems that aim to close the natural nutrient and water cycle.
The nutrition value of urine and faeces as fertilizer

<table>
<thead>
<tr>
<th>Fertilizer</th>
<th>500 litres of Urine</th>
<th>500 litres of Faeces</th>
<th>Total</th>
<th>Fertilizer needs of 250kgs of cereal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>5.6kg</td>
<td>0.09kg</td>
<td>5.7kg</td>
<td>5.6kg</td>
</tr>
<tr>
<td>Phosphorous</td>
<td>0.4kg</td>
<td>0.19kg</td>
<td>0.6kg</td>
<td>0.7kg</td>
</tr>
<tr>
<td>Potassium</td>
<td>1.0kg</td>
<td>0.17kg</td>
<td>1.2kg</td>
<td>1.2kg</td>
</tr>
</tbody>
</table>

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Ecological latrine design

• Ecological latrines can be divided into two main types: (i) dehydrating urine separating toilets and (ii) composting toilets.

(i) Dehydrating urine separating toilets

• The urine and faeces are collected and stored separately by the use of specially designed pedestals and slabs
• The urine is collected and stored until it can be used as a fertilizer on plants or crops
• The faeces drops into a pit, vault or container to which a handful of either ash or lime is added. This has the effect of drying the faeces and increasing the pH which has a positive impact on reducing smell (less ammonia emission) and destroying pathogens

• After 12 months of storage the resulting ‘humanure’ can be applied to the land.
(ii) Composting Pit Latrines

• Household systems for composting night soil and other organic material (ash, sawdust, peat, straw, organic household waste or similar substances) are used under a variety of conditions.

• They are used successfully in both developing and industrial countries when there is an urgent need for organic fertilizer or when there is a high degree of environmental concern.

• There are two types of composting toilets: continuous & batch composting toilets
B. Non-network, water-dependent excreta disposal methods (no transport, and with water)

I. Septic Tanks

• rectangular chambers cited below ground level, that receives both excreta and flush water from the toilets as well as other household wastewater.

• with retention time of 1-3 days, solids settle and are digested anaerobically, to produce: thick scum effluent and sludge

• Desludge once every 1-5 years
II. Pour-flush toilets
• Similar to conventional pit latrines except for the floor slab which carries a u-shaped water seal or trap bowl.
• The water seal prevents the passage of odour and fly breeding.
• 2 designs: pit directly below latrine; and pit is offset.

III. Aqua privy
• Essentially a septic tank located directly underneath a squatting plate which has a 100-150mm diameter, vertical drop-pipe extending some 100mm below the liquid level in the tank, thus forming a crude water seal.
Septic tank

Pour-flush toilet
<table>
<thead>
<tr>
<th>System</th>
<th>Principles</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| Aqua privy      | It consists of a tank filled with water into which excreta drop through a pipe or chute hanging from the latrine floor. It undergoes biological decomposition, reduces in volume and flows into a soak away. It has 4 parts—a tank with a seat and drop pipe, a roof, and a soak away. | - more aesthetic,  
- little or no odour  
- simple, inexpensive  
- can be near dwellings  
- less amenable for abuse  
- preferred where water table is high | - cost higher than pit latrine  
- Needs some water (about 40 l per day is adequate)  
- needs daily upkeep  
- desludging needed at intervals |
| Septic tank     | Useful in low-density households, institutions, schools and hospitals. It is usually designed to take waste water from toilets, kitchen, bathroom and others. The waste water stays for at least 1 day but up to 3 days and stabilized before entering into a soak away. | Here settlement of heavy solids, flotation of oil and grease as scum and partial decomposition of organic matter takes place. Hook-worm and Ascaris eggs are destroyed to a great extent. | Need to be desludged once in 1-4 years.  
-Too much accumulation of scum and sludge will reduce the volume of liquid  
-Fresh sludge may still contain pathogens |
Faecal Sludge Management

Faecal Sludge: Comprises all liquid and semi-liquid contents of pits and vaults accumulating in on-site sanitation installations (latrine, toilets, septic tanks and etc.)
What is Faecal Sludge Management (FSM)?

FSM is a **management** system that safely collects, transports, and treats **faecal sludge** (also called septage) from pit latrines, septic tanks or other onsite sanitation facilities.